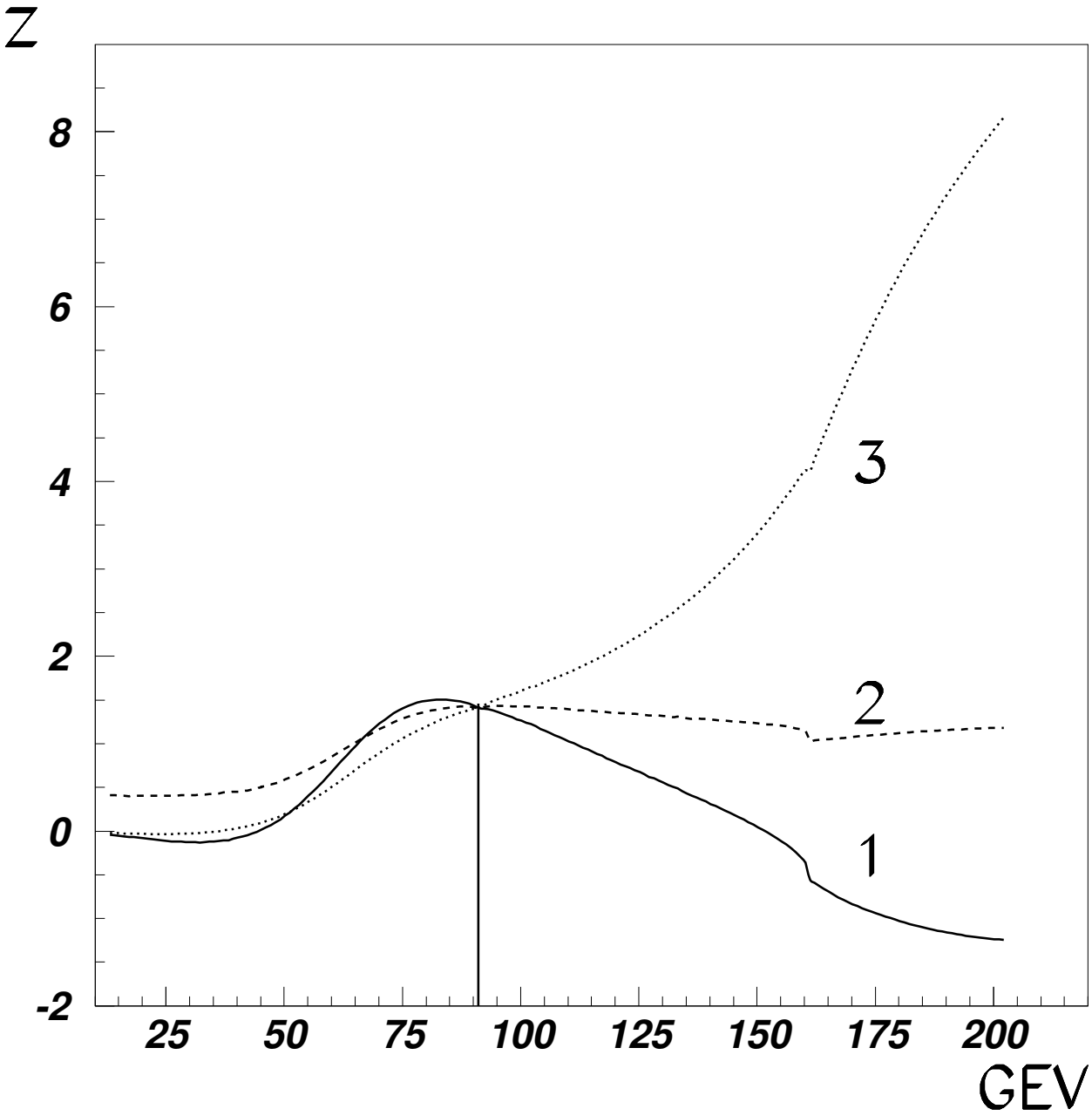
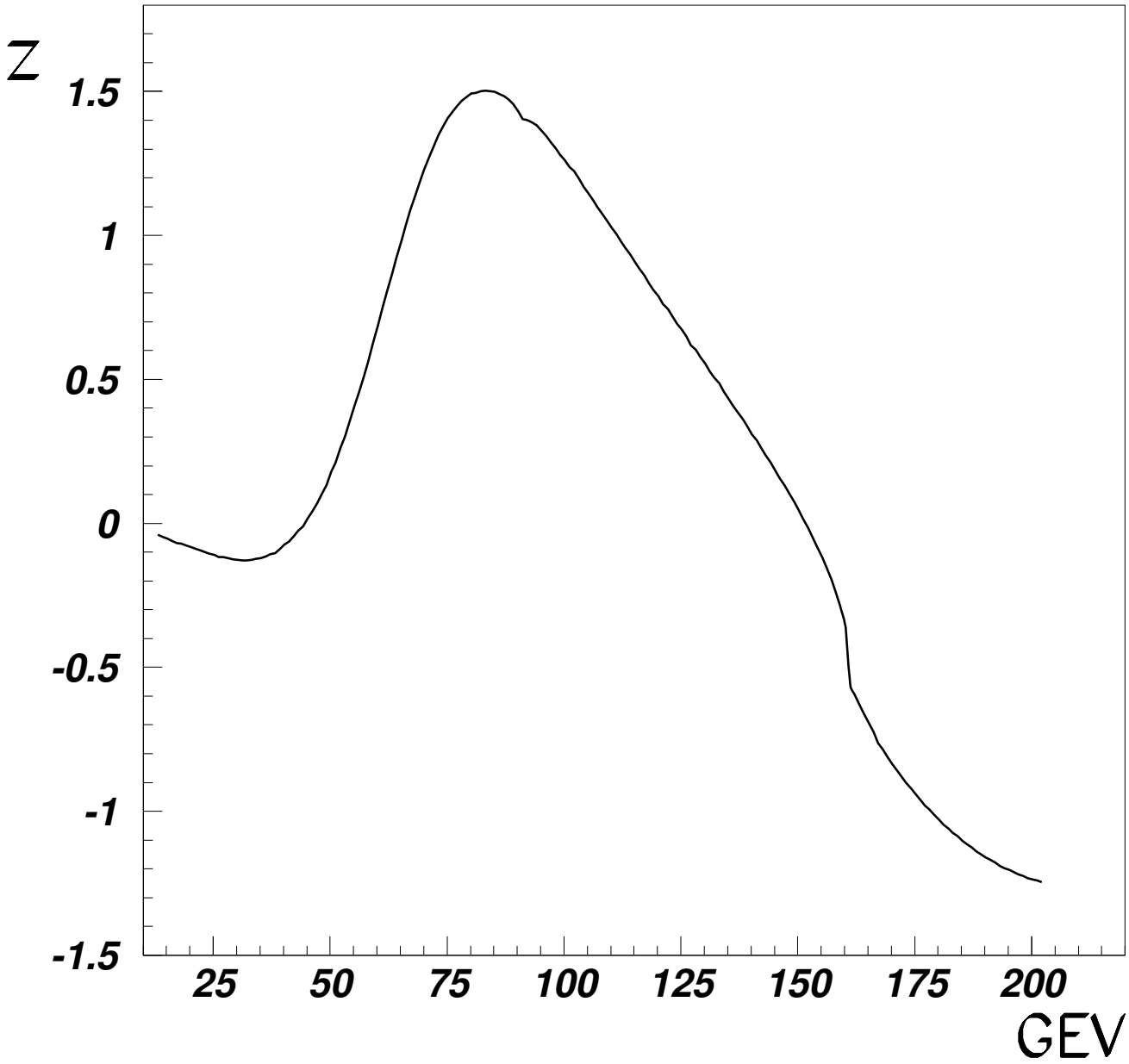
- **THE OFF-RESONANCE CONTRIBUTIONS FROM $V^{AB,NAB}(s)$ and $B^{WW}(s)$ ARE VANISHINGLY SMALL AT LEP1 ENERGIES**
- **HOWEVER, THEY ARE VERY IMPORTANT BEYOND RESONANCE, IN PARTICULAR AT LEP2**
- **TO PRESERVE GAUGE CANCELLATION IT IS NECESSARY TO ADD BOX CONTRIBUTION**


Z
8
6
4
2
0
-2
25
50
75
100
125
150
175
200
GEV
1
2
3


Z
1.5
1
0.5
0
-0.5
-1
-1.5
25
50
75
100
125
150
175
200
GEV

$$R \quad = \quad \frac{\sigma^{IBA}_{e\bar{e}\to d\bar{d}} \quad - \quad \sigma^{IBA}_{e\bar{e}\to b\bar{b}}}{\sigma^{IBA}_{e\bar{e}\to d\bar{d}}}, \%$$

DOUBLE DECONVOLUTED →

- **NO ISR QED**
- **NO FSR QED× QCD**

$\sigma^{IBA}_{e\bar{e}\to d\bar{d}}$ → **UNIVERSAL**

$\sigma^{IBA}_{e\bar{e}\to b\bar{b}}$ → **UNIVERSAL + NON-UNIVERSAL**

$$\Big| V(s) + B(s,t)$$

$$A = \frac{1}{s - M_z^2 + iM_z\Gamma_z}\left[V^{Zbb}(s) + \left(s - M_z^2\right)\left(\frac{V^{\gamma bb}(s)}{s} + B^{WW}(s,t)\right)\right]$$

$$\begin{aligned} V \quad &= \quad V_0 \quad + \quad V_t \\ B \quad &= \quad B_0 \quad + \quad B_t \end{aligned}$$